The omission is probably due to the fact that the process in question (Riecken's) has not been worked on a large scale except during the last three or four months, though the patent is three years old. Its efficacy depends essentially on securing a clean mercury kathode in the form of a thin stream of mercury flowing over a nearly vertical copper plate.

The liquid containing the pulverised ore is a continually agitated solution of cyanide and the anode is of iron, as the electro-motive force, one and a half volts, liberates nothing more corrosive than cyanogen. The particles of gold are doubtless cleansed of the obstructing sulphide and tellurous films by the convection currents of ionised cyanogen and also, in a more direct way, by the current as it passes through each particle, making in effect one side of it a kathode and the other an anode, just as is seen if we suspend a piece of metal in an electrolyte between the electrodes and unconnected with either.

This simple invention may revolutionise the treatment of refractory ores, yet apparently the inventor could get no hearing for three years till, at his own cost, he erected apparatus on a working scale in West Australia. The facts are valuable as showing how great an interval separates German intelligence from British engineering practice.

Intelligence of any kind, foreign or native, must indeed have been wanting when huge works, regardless of cost, were erected in presence of the published electrolytic method which could have been effectually tested in a single vat.

JOHN HILL TWIGG.

IF, as your correspondent, Mr. Twigg, says, Riecken's electrolytic process has only been worked on a large scale during the last three or four months, it is not unnatural that Mr. Blount has omitted to describe it. In most cases Mr. Blount has endeavoured to describe processes which are of proved utility, and therefore it was hardly necessary to draw attention to the omission. Further, the number of patents on the subject of electrolytic gold refining is very large, so that it would be manifestly impossible to describe them all. Riecken's process is a very neat one, and should any of the readers of NATURE be interested in the subject, an excellent description is to be found in the "Jahrbuch der Electrochemie" (vol. v. p. 380).

F. MOLLWO PERKIN.

Unusual Agitation of the Sea.

ON Wednesday, April 24, on going to the edge of the cliff above Alum Chine, Bournemouth, at 7.50 a.m., I was struck by the appearance of a succession of waves, resembling a slight ground swell, reaching the shore from an otherwise calm sea, there being no wind. The character of the waves was rather peculiar, and I then saw that every now and then, at intervals of about two or three minutes, much larger waves came in, and instead of breaking abruptly, extended quietly up the sandy beach to a greater height than was expected from their apparent elevation. I mentioned the phenomenon on reaching the house, and on the suggestion that the waves were the result of a distant storm, could not see that they might be so accounted for. Between 12 and 1 p.m. I again watched the undulations, and roughly measured the length on the beach by which the larger waves extended further than those of ordinary size. This was about 22 feet. The larger waves were less frequent than in the morning. Later in the afternoon, soon after 3 o'clock, some of my family were caught by the exceptionally large undulations, which rose surprisingly high upon the slightly sloping sand.

I have not heard whether any remarkable disturbance has been recorded by the seismometer, but I see in the *Daily Mail* and *Daily Express* of April 25 and 26 telegraphic reports of earthquakes in Italy, Portugal and Guernsey on April 24.

ROLLO RUSSELL.

RECENT DEVELOPMENTS IN ELECTRIC SIGNALLING.

IT is thirteen years since Hertz carried out the brilliant series of experiments which, apart from their great theoretical value, had the important effect of laying the foundation of modern systems of wireless telegraphy. Three years later we find the *Electrician* making the suggestion that the discoveries of Hertz might be utilised for signalling to lightships, and five years later still, in 1896, Signor Marconi brought over to England the first practical wireless telegraphic apparatus and awakened public interest by the remarkably successful experiments which he carried out on Salisbury Plain and across the Bristol Channel. For a time the technical and lay Press was full of wireless telegraphy; great prospects were predicted for it; communication with lightships and lighthouses was the least of the feats it would accomplish; telegraphy at sea was to become as common as on land; some even went so far as to say that wires and cables of all sorts for telegraphic purposes were to become a thing of the past. But these revolutionary changes, if they are ever to be made, did not come with the rapidity which many apparently expected. It was soon recognised that we needed to know a great deal more about the subject before Hertz waves were to be even a trustworthy servant to the telegraphist, and even now we can scarcely call wireless telegraphy much more than experiment. But we have now more definite grounds for feeling sure of its ultimate success, and we can predict for it a useful future with much more surety and reason than was done in the first outburst of enthusiasm that followed Mr. Marconi's experiments.

The patient and persevering experimenting of the past five years has led to the gradual surmounting of many of the difficulties which at first beset wireless telegraphy, and Mr. Marconi, Prof. Slaby and the other pioneers who have thrown themselves with vigour into its development have met with a success which, if not complete, is yet very promising. It is not the greatly increased distance over which it has become possible to signal, an increase from a few miles in 1896 to more than 200 in 1901, that marks the most important development that has occurred. The greatest achievement is the successful solution of the problem of tuning. It was early seen that before wireless telegraphy could have at all an extended utility it would be necessary to find some means of confining each message to its correct destination and of preventing each receiving apparatus from responding to Hertz waves sent out from any transmitter in its neighbourhood. It seems that now almost all experimenters have overcome this difficulty, at any rate to a certain extent.

The improvement in distance over which it is possible to signal has been very marked. The empirical law put forward by Mr. Marconi that, other things being equal, the distance over which signalling would be possible was proportional to the product of the heights of the masts at the two ends seems to be fairly well established as a working rule. But the improvements in transmitting and receiving apparatus have been so great that it is now possible to signal over much greater distances with the same heights of masts than was the case in 1898. For example, in 1898 Mr. Marconi was only able to cover 15 miles with vertical wires 120 ft. high, whereas to-day, according to the recent announcement made by Prof. Fleming, a distance of 200 miles from the Lizard to St. Catherine's, Isle of Wight, has been signalled over with masts only 160 ft. high. Mr. Marconi certainly holds the record for long distance work. The example just quoted refers to signalling across sea; across land such great distances have not been attained, but here again we think the credit of having signalled over the greatest distance must be given to Mr. Marconi, who established in 1899 communication between Dovercourt and Chelmsford, a distance of more than 40 miles.

These long distances have been attained by Mr. Marconi partly by the use of a specially constructed transformer in the receiving circuit. Instead of connecting the vertical receiving wire in series with the coherer it is connected in series with the primary of this transformer, the secondary of which is in series with a condenser and the coherer. By this means the voltage of

the received oscillations is increased, and the resistance of the coherer more easily broken down. A somewhat analogous arrangement is used by Prof. Braun, to whose work allusion has already been made in NATURE,[1] in the transmitting circuit, the oscillations in the vertical wire being set up by induction and not by directly including the spark gap between the vertical wire and earth. The results that have been obtained by Prof. Braun are not, however, nearly so good as Mr. Marconi's latest work.

So far as tuning is concerned, Mr. Marconi appears to have successfully got over this difficulty. Prof. Fleming, in the lecture above referred to, stated that the communication between the Lizard and St. Catherine's was multiplex, it being possible to receive two or more messages at once at each place. Mr. Marconi himself, in an interview with an American contemporary, said that with his improved apparatus he could send or receive 2, 10 or 50 messages at the same time, without any interference whatever. Particulars as to the method have not, however, been published as yet, but it is to be hoped that the details of the system will be explained by Mr. Marconi at his forthcoming lecture at the Society of Arts.

In Germany the subject of wireless telegraphy has been tackled principally by Prof. Slaby and Count Arco, who took up the subject in order to find a system for the German Navy, to replace that of Mr. Marconi, the Marconi Company charging, it was said, prices prohibitive to any but the English Navy. Although the results, so far as distance is concerned, which Prof. Slaby has obtained are not very great, the system that he has developed is one of great interest and seems to be founded on sound scientific principles. Prof. Slaby has aimed throughout at getting rid of interference by producing only oscillations of a definite wave-length and tuning the receiver only to respond to these particular waves. In order to produce the oscillations, the transmitting circuit is arranged as shown in Fig. 1. An earthed loop of wire, ACDE, is used, instead of the single insulated vertical wire usually employed, in one arm of the loop there being a spark gap, AB, and a condenser, K. The ends C and D of the vertical wires are joined by a coil of wire as shown. In charging the condenser the whole loop is used, but in discharging it is only the arm ABC which is utilised, the coil of wire CD preventing the oscillations passing into the remainder of the circuit. Upon the length of the wire KC and the capacity of the condenser K the wave-length of the oscillations depends, and from their known values it can be calculated.

Theoretical considerations showed Prof. Slaby that the free ends of both the transmitting and receiving wires, *i.e.* the ends C and E (Fig. 2), are potential loops, and that the earthed ends B and D are potential nodes. If, now, to the receiving wire DE a second wire, DF, equal in length to CD, is connected, there will be a potential loop at F. At E and F, therefore, the potential will vary over a much greater range than at D. If at F a further length of wire, J, is attached, such that its length is half a wave-length, then there will be established between F and the free end, G, of the coil J a difference of phase of 180°. At both points there will be potential loops, but when the potential F has a maximum value in one direction that at G will have a maximum value in the opposite direction, and the potential difference between F and G will be double that between F and earth. By connecting the coherer between F and G it can thus be made to respond to received oscillations much feebler than those which would be required to work it if it were connected, as is usual, between D and earth. As an additional advantage, the earth connection at D can be removed, and the whole receiving apparatus thus rendered earth free.

Experiments have been made from time to time to devise a suitable repeater for use with wireless telegraphy, and the results of some work which has been done by M. Guarini on this subject were recently published in the *Electrician*.[1] M. Guarini established stations at Brussels, Malines and Antwerp; messages were successfully transmitted between Brussels and Malines and also between Malines and Antwerp, and a repeater was then set up at Malines with the object of automatically transmitting the messages received from Antwerp to Brussels. The experiments were not, however, very successful, as the repeater did not always transmit the signals, and it was found, consequently, impossible to send any actual messages. A trustworthy repeater for wireless telegraphy would be very useful, but it is scarcely necessary to point out that it must be absolutely trustworthy, as if a man has to be on the spot to keep it up to its work he may as well be employed in retransmitting the messages.

In the meantime the wire-using telegraphists have been by no means panic stricken by the achievements of their wireless competitors, and some very notable developments have taken place during the past few years. We can only describe here a few of these; those who are more deeply interested in the subject may be referred to Mr. Gavey's paper on telegraphs and telephones at the Paris Exhibition, read recently before the Institution of Electrical Engineers,[2] in which will be

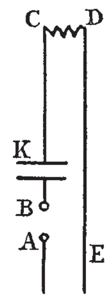

FIG. 1.

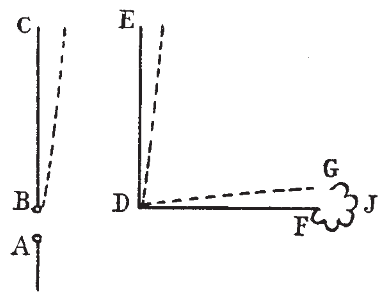

FIG. 2.

found descriptions of all the more important improvements effected in the last few years. One of the most remarkable is the Pollak-Virag high-speed telegraphic system. This system attracted considerable attention both in the technical and lay Press when it was first brought forward, towards the end of 1899, on account of the extremely high speed of signalling which it was said to be possible to attain by its use. It was reported that in trials in America a speed of 60,000 words an hour had been maintained over a line which was over 1000 miles in length, and that a speed as high as 100,000 words an hour had been attained. This is a very great improvement on the 400 or 500 words a minute possible with the Wheatstone automatic or Delaney multiplex systems, which are those commonly in use in this country. These remarkable results had been achieved by the use of a telephone diaphragm as the receiving instrument, the diaphragm being deflected by the currents received through the telegraph line and a deflection in one direction corresponding to a dash and in the opposite direction to a dot. The movements of the diaphragm were recorded photographically, a small mirror being attached to the diaphragm and a ray of light being reflected from this on to a revolving drum covered with a roll of sensitised paper. The record had, of course, to be subsequently developed in the ordinary manner.

Since its first introduction the system has undergone considerable development, a very ingenious modification

[1] NATURE, 1901, vol. lxiii. pp. 403 and 474.

[1] The *Electrician*, March 22, 1901, vol. xlvi. p. 819.
[2] *Journal* of the Institution of Electrical Engineers, 1901, vol. xxx. p. 73.

having been introduced by means of which the recorded message is written in ordinary Latin characters and can consequently be read by any one. In order to do this it is necessary to give the mirror on the receiving instrument a horizontal as well as a vertical motion, and for this purpose two circuits are needed and two telephone diaphragms, one giving the mirror vertical movements and the other horizontal. A single metallic loop is employed, one telephone being put in the loop and the other between the loop and earth. Horizontal movements of the mirror, to right and to left, are produced by currents passing round the loop in one direction or the other respectively, and vertical movements by currents passing from the loop to earth ; in this second case an upward movement is produced by a current in one direction and a downward movement by a current in the opposite direction, and also a downward movement of double the distance by a current at double the normal voltage.

PERFORATIONS.

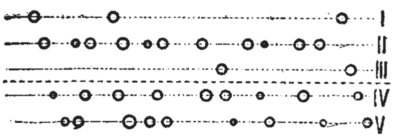

FIG. 3.

VERTICAL.

FIG. 4.

HORIZONTAL.

FIG. 5.

RESULTANT

FIG. 6.

The line currents are sent by means of perforated strips of paper much in the same way as in the Wheatstone transmitter, but five strips are used, three to give the vertical components and two for the horizontal. These strips are shown in Fig. 3 ; the rows marked i, ii and iii give the vertical components, the first row giving the tall letters and the third the deflections of double amplitude for the letters with tails ; rows iv and v give the horizontal components. Deflections of a fraction of the normal amplitude are given by contacts lasting a shorter time by means of the small perforations as seen in rows ii, iv and v. The perforations are so arranged that the combination of the vertical and horizontal movements of the mirror (as seen in Figs. 4 and 5 respectively) gives the Latin characters (Fig. 6), and all the perforations for one letter are punched at the same time by means of a special machine of the typewriting kind. To obviate the difficulty of having to use a rapidly moving narrow strip of sensitised paper to receive the photographic record, as in a tape machine, a very neat device is employed. The source of light is the filament of an incandescent lamp, which is surrounded by an opaque cylinder in which a helical slit is cut. This cylinder is revolved, and as it turns the part of the filament acting as a source of light moves from left to right as the slit uncovers in succession the various portions of the filament ; at the same time, the spot of light reflected on to the recording paper, which is a broad band of sensitised paper, will also move from left to right, thus writing a complete line on the paper ; at the end of a complete revolution the spot will return again to the left-hand side of the paper band and will proceed to write a new line, this new line being brought under the other by a movement imparted to the band of paper. The message is thus directly obtained as an ordinary written message in lines one below the other, and the system has thus the great advantage over all Morse methods that the message has not got to be deciphered and transcribed by the receiving telegraphist. With this apparatus it is said that a speed of 1000 words a minute can be obtained.

The Pollak-Virag system, although in its most recent form it gives a record in ordinary handwriting characters, must not be confused with those systems designed to transmit the actual handwriting or drawing of the signaller. Several instruments, under the name telautographs, have from time to time been devised for this purpose, and the late Prof. Elisha Gray was, we believe, engaged on the perfecting of an invention of a telautograph at the time of his death. The attempts at solving the problem, which is, it must be confessed, a very fascinating one even though the very extensive utility of such an instrument may be questioned, have not, so far, proved very successful. Last year, however, there appeared in the technical Press descriptions of a telautograph which is the invention of Mr. Foster Ritchie, and which seems to have got over the difficulties in a very practical manner. In the Ritchie telautograph the message is written with an ordinary pencil ; by means of levers attached to this pencil its movements are made to regulate the currents sent through the transmitting lines, and these currents in their turn regulate the motion of a pen at the receiving end. By an ingenious arrangement the receiving pen only makes marks on the paper when the transmitting pencil is pressed down on the writing table. The receiving pen exactly reproduces the characters written at the transmitting end, which can be written at the ordinary speed of handwriting. We hope on a later occasion to give a more detailed description of the apparatus.

We may finally describe an invention which has aroused considerable interest amongst our American cousins, namely, Dr. Pupin's system of long distance and oceanic telephony. Dr. Pupin has, we understand, disposed of his American patent rights to the American Telephone and Telegraph Company for a very large sum of money, which shows that this company have great confidence in the invention. The difficulty of carrying out successful telephony over a great length of line arises out of the fact that the line possesses both resistance and capacity ; this is especially the case with submarine cables in which the capacity is large. These properties produce both attenuation and distortion of the transmitted signals, the arrival current being both very much weaker and different in character to the current sent into the cable at the transmitting end. The alteration in character is due to the fact that the more rapidly varying currents are more easily attenuated ; if a varying current be sent into the cable by speaking into a telephone at the transmitting end this may be analysed, just as the sound to which it corresponds may be analysed, into a fundamental vibration and a number of higher harmonics ; the higher harmonics will, after travelling along the cable to a certain distance, become so attenuated that they will be incapable of producing any effect on a receiving telephone, so that such an instrument, if placed at this point, will only

be actuated by the fundamental lower harmonics, and the sound it gives out will, in consequence, be different in character from the sound originally made at the transmitting end. The effect will show itself, therefore, in defective articulation, or distortion of the sounds arising out of the distortion of the telephone currents.

It has been shown by Mr. Oliver Heaviside that there are ways in which this distortion may be prevented and a "distortionless circuit" constructed. Without entering too deeply into the subject we may point out briefly the methods by which this may be effected. Since the cable possesses capacity, the first effect of sending current into it is to charge it, and no signal can be received at the far end until the cable is partly charged, and no further signal until the charge has had time to get out. Now if the insulation resistance of the cable be diminished, the charges will more readily leak out and thus it would be possible to expedite signalling; but at the same time the attenuation is increased, for more of the current will leak out of the cable; the remedy is, therefore, only a partial one, for though the speed of signalling may be increased, so much current will leak out on the way that the amount arriving at the far end may be too small to work the receiving instruments. Instead of simply diminishing the insulation resistance or of distributing artificial non-inductive leaks along the cable, inductive leaks may be placed at definite points along the cable; this method was proposed by Prof. S. P. Thompson in a paper read at the International Congress at Chicago in 1893.[1] A diagram of the cable construction suggested by Prof. Thompson is shown in Fig. 7; the capacity is represented as though it were not evenly distributed but

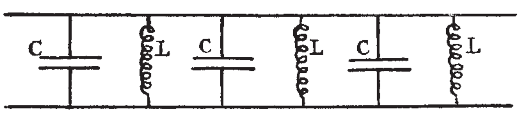

FIG. 7.

consisted of a number of condensers, C,C, connected as shunts to the cable; the inductive leaks are represented by the coils L,L. The capacity and self-induction are therefore combined in parallel, and it is well known that they can be combined in this way so as to behave, for a definite frequency, exactly as an ohmic resistance. The capacity of a submarine cable may be partially neutralised in this way, but the remedy is only a partial one for three reasons. Firstly, the inductive leaks, to correctly neutralise the capacity, should, like the capacity itself, be evenly distributed along the cable and not distributed in jerks; secondly, the correction will only be exact for a particular frequency; lastly, the leakage is increased and the same defect consequently occurs as in the case considered above in which the distortion was corrected by diminishing the insulation resistance. Theoretically, therefore, the system proposed by Prof. Thompson does not offer a perfect solution or give a truly distortionless circuit; but it would greatly diminish the distortion, though at the same time increasing the attenuation, and might therefore give a practical means of increasing the speed of signalling or even obtaining telephonic communication over the cable.

As Mr. Heaviside has shown, the only true way of obtaining a distortionless circuit—of obtaining *the* distortionless circuit, as he calls it—is to balance the effect of capacity by self-induction *distributed along* the cable in series with it and not as a leak to it. The four quantities which control the propagation of disturbances or signals along the line are its resistance, R, its external conductance, or conductivity of the insulation, K, its self-induction, L, and its capacity or "permittance," S, and the signals will be propagated without distortion if L/R = S/K. The equality of these two ratios may be obtained by altering any of the four variables, but practically we may consider R and S as fixed. In ordinary cables the value of the ratio L/R is very small, and that of S/K comparatively large. In order to make the two equal we may increase K, that is to say diminish the insulation resistance, but this, as we have seen, leads to excessive leakage and is not, therefore, desirable. The method suggested by Prof. Thompson amounts practically to converting the capacity, S, partly or wholly into insulation conductivity, K, and thus diminishing S/K until it is as small as L/R. The self-induction coils added in this system must not be confounded with the self-induction of the cable L, for they are added as shunts to the cable. The ratio L/R may also be made equal to S/K by adding self-induction coils in series with the cable, thus increasing the value of L; this is the solution adopted by Dr. Pupin. Here again the ideal solution is only obtained when the self-induction is evenly distributed, but a practical solution can be obtained by placing coils at intervals along the cable.

Dr. Pupin, besides repeating a good deal of Mr. Heaviside's theoretical investigations, worked out the necessary values of the self-induction of the coils and the maximum distance apart at which they can be placed in order to imitate sufficiently well an evenly distributed self-induction. He then proceeded to build some coils and to experiment with them on an artificial cable. The results of some of these experiments are interesting, as they point to the great improvement the addition of the

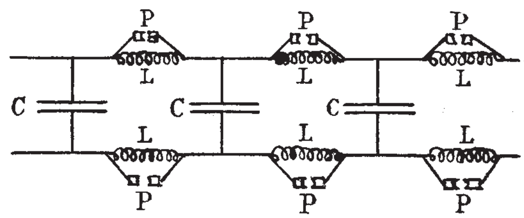

FIG. 8.

inductance produced. An artificial cable was built up with condensers in the usual way in 250 sections, each section representing a mile of cable; between each section were placed induction coils which could be short-circuited by plugs. A diagram of this cable is given in Fig. 8; as before, the capacity is represented as if it consisted of condensers, C,C; the induction coils are shown at L,L; these coils are short-circuited by inserting the plugs at the contacts P,P. When all the coils were in circuit telephonic communication could be carried on with perfect ease over the whole length, 250 miles, of the cable; when, however, the coils were short-circuited conversation was good up to 50 miles only, fair up to 75, impracticable at 100 and impossible beyond 112. It must be remembered in considering these results that the cable was an artificial one and that possibilities of error are consequently great, so that the results must not be transferred with too much confidence to the case of an actual cable.

Apart from this, however, the results are extremely good, and Dr. Pupin is to be congratulated on having obtained experimentally a practically distortionless circuit. It is perfectly true, no doubt, that Mr. Heaviside had obtained the solution already theoretically; but the engineers generally require to have their attention attracted by actual experiment and are not too prone to make changes on a theoretical basis only, however sound. Whether a cable can be commercially constructed on the lines of Dr. Pupin's artificial cable is a question for the practicians; we have no doubt that, now its advantages have been demonstrated, they will be able to find a way. The enormous advantage of Transatlantic telephony can never

[1] See the *Electrician*, August 1893, p. 439.

for a moment be questioned; it means much more than that we shall be able to telephone to America; it means that we shall be able to telegraph at the speed of the automatic transmitter. The present speed of Transatlantic telegraphy is something like 20 words a minute, and there are 12 duplexed cables having, therefore, a carrying capacity of about 500 words a minute. A single distortionless cable, built on Dr. Pupin's plan and working with an automatic transmitter, would have, therefore, a carrying capacity equal to that of all the existing cables.

INDIGO AND SUGAR.

THE Behar Sugar Commission, which was appointed in October of last year to see whether improvements might not be made in the cultivation and manufacture of cane sugar, has completed its task. The report has been issued with commendable promptitude—scarcely five months having elapsed from the appointment of the Commission to the presentation of its report. The Commission was primarily appointed because of the perilous position of the indigo industry, to see whether it might not be possible to grow the sugar cane and indigo crops in rotation.

The *Times* of April 15 contains an article upon this report. One thing the Commission seems to have made clear is that the methods employed in the sugar industry have been on the same happy-go-lucky slip-shod fashion as those until lately used in the manufacture of natural indigo. The yield of sugar per acre in India averages about one ton, whereas in Barbadoes it is three tons, and four tons are obtained in Java.

The Indian Government, taking alarm at the great increase in the imports of beet sugar and wishing to aid the indigenous planter, imposed countervailing duties in March 1899. The duties have apparently failed in their object, as the imports of beet sugar for 1900 were greater than for 1898. It would appear that very little attempt has been made in India "to treat the soil or plant the canes on scientific principles," and that the methods of refining the sugar are rough, crude and wasteful, so that under such conditions the yield of the finished article is not what it should be, and the quality is poor; Indian sugar is, therefore, unable to compete with sugar refined by modern scientific methods and appliances.

It is further stated that there is an increasing tendency in India to prefer sugar which has been refined to unrefined sugar. The Commission recommend the employment of modern and up-to-date apparatus. We are glad to note that they do not recommend indiscriminate help to the individual planter or refiner, but suggest that such assistance as is desirable should be given in helping systematic experiments at a central station.

Turning now to the indigo industry, which was the primary cause of the appointment of the Commission, we find that the indigo planter, now thoroughly alive to the danger which threatens him, is exerting himself to improve the yield of indigo. In the first place, by the employment of artificial manures, principally superphosphates, an increased plant production of from 50 to 100 per cent. has been obtained. In manufacturing indigo, it will be remembered (NATURE, November 1) that it is usual, when the plant has reached maturity, to cut it near to the ground and to steep the whole plant. After a few months the fresh shoots which have sprung up are again cut, but the yield of indigo from this second crop is inferior to that obtained from the first. It has been suggested, seeing that almost the whole of the colouring matter is contained in the leaves, that the plant should not be cut down, but that the leaves only should be stripped off and steeped. It is calculated that four or five strippings could be obtained during the manufacturing season, and thus a very much larger quantity of indigo would be produced than by the methods at present in vogue.

The old beating process for oxidising the liquors obtained after the plant has been steeped is gradually being replaced by the use of the "blower." In this method air is blown through a number of perforated pipes which are placed at the bottom of the vats, with the result that oxidation is more rapid and complete, and about 25 to 30 per cent. more colouring matter is produced than by the old process. Mr. Rawson, in addressing a meeting of those interested in the indigo industry at Calcutta on February 20, said that the output of indigo in North Behar last year amounted to about 60,000 maunds,[1] and that at least 12,000 maunds more would have been produced had the new "blowing" process been employed.

A manufacturing industry, such as that of indigo, which is to a large extent dependent upon atmospheric conditions, has naturally seen many dark days. But when the supply has been short there has generally been an enhancement in prices. The Commission is of opinion that a rise of price owing to bad seasons or short supplies can no longer be looked for, and say in their report: "It is reasonable to anticipate that the competition of synthetic indigo will prevent any future increase in the price of vegetable indigo, that it will soonest and most injuriously affect the finest and most expensive indigo, which is that of Behar, and cause a further reduction in price, which would hardly clear the planter in a good season, while a bad season would be ruinous to him." They go on to say, "it is obviously expedient that indigo planters should possess in sugar and other products resources which, if they are carefully and intelligently utilised, will enable them to contemplate the future of indigo with equanimity."

In order to aid the Indian indigo industry, the Bengal Government has formally agreed to grant an annual subsidy of 50,000 rupees for three years for further chemical and scientific researches with regard to indigo cultivation.

Indigo planters claim that at present the natural dye can be placed on the market at prices which can undersell the synthetic product. This is good news, but it is difficult to see how it is in the long run to hold its own against the artificial product, which is of uniform quality, requires no grinding, and is unaffected by vicissitudes of weather.

Prof. Armstrong, in a long letter to the *Times*, says that "The truly serious side of the matter, however, is not the prospective loss of the entire indigo industry so much as the fact that an achievement such as that of the Badische Company seems to be past praying for here."

Whether or not the natural indigo industry is to become a thing of the past remains to be seen, but if the replacement of natural indigo by a synthetic article produced in Germany leads British manufacturers to realise more fully the importance of trained scientific assistance, the decline, although in itself a great calamity, might not be entirely without its compensations.

Since writing the above, I have received a copy of an address upon "The Synthesis of Indigo," delivered by Prof. Meldola before the Society of Arts on April 17. In introducing the subject Prof. Meldola says that it is now often considered unpatriotic to "call public attention to any branch of industry in which we are being beaten by foreign competitors." He, however, considers that "The real enemies of British industry are those who, by virtue of their positions as politicians, economists, or as men of science, try to blind the public and to allure the manufacturer and merchant into a fool's paradise of false security."

[1] The Bengal factory maund is 74·66 lbs.